Plutonium Finishing Plant (PFP) Glove Port Monitor

The Challenge

At the Hanford Site's Plutonium Finishing Plant (PFP), Special Nuclear Materials (SNM) are placed in various containers during processing, storage, and for waste disposal. The amount of SNM in each item must be known for safety during handling and storage, and for safeguards accountability. As SNM items are moved between storage and gloveboxes during stabilization activities, accurate accounting becomes more difficult. Also, in-process materials in gloveboxes must be periodically checked to determine the amount of SNM present for inventory control purposes. Handling and waste management costs could be reduced if improved methods for the plutonium measurement process are developed.

Gloveport Monitor system components including the germanium gamma detector (foreground), neutron counter (right), counting electronics and laptop on the table (center back).

Current Approach

In order to measure the SNM content in an item which is inside a glovebox, the item is transferred out of the glovebox using a method called a seal-out. Operators and radiological control technicians don Personal Protection Equipment (anti contamination clothing and respirators), place the affected airspace on Airborne Radioactivity Status, and then use a plastic bag and heat sealer to move the item out of the glovebox and separate the plastic containment. This process is designed for worker protection and safety. It is a costly and labor-intensive practice. Other operational activities in the same facility airspace are impacted during the seal-out process due to the increased potential for personnel radiation exposure.

The items are moved to Nondestructive Assay (NDA) counters to ascertain the amount of SNM they contain, then transferred back to the glovebox via a sphincter port or a seal-in, or to waste disposal, or to vault storage locations.

There is also a specific group of stored items with either unusual container sizes or high matrix densities which the existing in-plant stationary NDA equipment is not well-suited to measure properly. These items would require dose intensive repackaging for measurement on existing NDA equipment. Alternatively, the cost, dose, and risk to destructively analyze these items would be very high and also require sample seal-outs. Another measurement method has been sought to improve the safeguards accountability and handling safety posture for these items.

Benefits and Features

- Minimizes TRU waste generation
- Addresses safeguards issues
- Supports As-Low-As-Reasonably-Achievable (ALARA) by minimizing radiation exposure to personnel
- Avoids risks of contamination spread inherent in seal out
- Airborne Respiratory Area setup, PPE donning, and downposting are not needed
- Convenient, portable device

New Technology

The Glove Port monitor is an easily used, transportable NDA system. Two counting detectors and the associated electronics for each are included in the system - a neutron measurement system, and a gamma-ray isotopic system. The ability to readily move this equipment will allow operators to set up the monitors next to a glove port with a seal-out bag attached. The operators will move the item into the seal-out bag, and then obtain a quantitative measurement of the SNM in the container.

The Glove Port monitor equipment may also be used to measure various containers in the field, due to the transportability of the system and the fact that it can handle a variety of container shapes and sizes up to 8" diameter and 12" tall.

Demonstration Description

The Glove Port Monitor technique, employing gamma-ray spectroscopy and neutron multiplicity and coincidence methods, was tested in May 1999, during plutonium inventory measurement verifications at PFP. Individual SNM items, similar to those produced during the reprocessing activities, were measured to demonstrate and define the system capability.

Demonstration Results

The initial demonstration showed the gamma counting portion of the system worked very well. The neutron detector also functioned properly. Electronics and software associated with the neutron detector did not provide expected accuracy during counting, and an off-the-shelf electronics and software package that complements the detector system is proposed for purchase. Since essentially the same neutron measurement system is in use at other DOE sites, this portion of the package is expected to function properly when received.

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